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USSR Report

MATERIALS SCIENCE AND METALLURGY

No. 80

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UDC: 669.782

INFLUENCE OF CHEMICAL INTERACTION ON NATURE OF FRACTURE AND STRENGTH OF D16-V COMPOSITE MATERIAL

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov-Dec 81 (manuscript received 7 Apr 81) pp 147-149

SHORSHOROV, M. Kh., KOLESNICHENKO, V. A. and YUSUPOV, R. S., Moscow

[Abstract] An earlier work showed that the nature of fracture and the tensile strength of the AD1-V composite material in the direction in which the boron fibers are laid depend on the degree of development of physical-chemical interaction between the fibers and the aluminum matrix. This work is a continuation of that work, and presents the results of studies performed for a composite material with a matrix of high strength D16 aluminum alloy, hot pressed at 400-500°C, 13 to 35 MPa. In all cases the holding time was 15 minutes. Depending on the hot pressing temperature, three characteristic strength zones are established resulting from the intensity of chemical interaction and the formation of intermetallides on the surface of the boron fibers. An equation is produced and experimentally verified for estimation of the strength of the composite material in the first phase. Figures 2; references 3: all Russian.
[59-6508]

UDC: 534.113:620.198

INCREASING DAMPING CAPACITY OF STRUCTURAL ELEMENTS CONTAINING COMPOSITE MATERIALS BASED ON DISCRETE FIBERS

Kiev PROBLEMY PROCHNOSTI in Russian No 12, Dec 81 (manuscript received 9 Mar 81) pp 60-63

KOLESNIKOV, B. Ya. and STRAKHOV, G. I., Moscow Institute of Civil Aviation Engineering

[Abstract] A study is made of the problem of effective utilization of materials consisting of a metal base glued to elements consisting of single-direction

discrete reinforcing fibers in order to produce the maximum damping capacity of the reinforced structures. Three directions are studied for solving the problem: 1) variation of the fiber length within the volume of the composite element; 2) variation of the geometry of the distributed material without changing the quantities; 3) a combination of both of the first two methods. It is found that varying the length of the reinforcing fibers is an effective means for increasing the damping capacity, while the use of composite elements with variable geometry can still further increase the effect of efficient distribution of fiber lengths. Figures 4; references 6: all Russian.
[61-6508]

UDC: 624.074:678.067

OPTIMAL FORMS AND TRAJECTORIES OF REINFORCEMENT OF ROTATING COMPOSITE SHELLS

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 5, Sep-Oct 81
(manuscript received 26 Nov 80) pp 846-854

BOKOV, Yu. V., VASIL'YEV, V. V. and PORTNOV, G. G., Moscow Institute of Aviation Technology imeni K. E. Tsiolkovskiy; Institute of Polymer Mechanics, Latvian Academy of Sciences, Riga

[Abstract] A basically new approach is suggested for the manufacture of flywheels of composites with reinforcement systems which have no transverse reinforcement or in any event assume that cracking of the binder is insignificant for the load-bearing capacity of the flywheel. This article studies the task of optimal planning of a flywheel in the form of a zero-moment envelope of rotation formed by winding or laying up orthotropic reinforced strips. Forms of the generatrix and trajectory of reinforcement are sought to provide the maximum load-bearing capacity for a given mass, and the energy capacities of such shells are estimated. After practical estimation of the desirability of manufacturing flywheels in the form of equally stressed zero-moment envelopes of rotation, it is concluded that their manufacture by winding is impossible, since the desired reinforcement trajectory differs significantly from any geodetic trajectory. Axial forces are required for reinforcement angles at the equator other than $\pi/2$ in order to assure equal stress. In shells with polar apertures the contour of the aperture should be attached to the shaft or hub. The specific mass energy capacity of optimal shells does not exceed the energy capacity of wheels or disks except where $\lambda > 2\sin^2\phi_1$. The main advantage of the new design is that there are no problems in connecting the products generated to a shaft. Great effectiveness of energy capacity can be expected by increasing the moment of inertia of the flywheel by the introduction of masses to the equatorial section or of fillers, particularly liquids, to the internal cavity, a problem which will be studied in a future report. Figures 3; references 11: 10 Russian, 1 Western.
[53-6508]

UDC: 678.067:620.172

INFLUENCE OF FIBER LENGTH DISPERSION ON TENSILE STRENGTH OF COMPOSITE MATERIALS WITH UNIDIRECTIONAL REINFORCEMENT

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 260, No 5, 1981
(manuscript received 5 May 81) pp 1099-1102

ZELENSKIY, E. S., BAZHENOV, S. L., GRIGORYAN, G. A., PUCHKOV, L. V., KUPERMAN, A.M., BERLIN, Al. Al., MANEVICH, L. I., PRUT, E. V. and YENIKOLOPYAN, N. S., academician, Institute of Chemical Physics, USSR Academy of Sciences, Moscow

[Abstract] Theoretical and experimental estimation is attempted of the influence of fiber length dispersion on tensile strength of a bundle of fibers (threads or roving) and microplastics. A mathematical model was constructed of the process of deformation and failure of the bundle of fibers. It was assumed that the probability of failure for a given stress and specimen length is described by a Weibull distribution. The problem was solved by statistical modeling using the Monte Carlo method in the following stages: the stress in each elementary fiber was determined for a given deformation and probability of its failure was calculated in accordance with the Weibull equation; comparison of the probability of failure with a uniformly distributed random quantity was used to decide whether each elementary fiber had failed; and the stresses in the fibers were defined as the sum of the stresses in the fibers remaining unbroken as related to the total number. Model specimens were built and tested to verify the mathematical results and it was established that the dispersion of fiber lengths actually does result in a significant variation in strength of fiber bundles and reinforced plastic products. Figures 4; references 4: 3 Russian, 1 Western.
[42-6508]

CORROSION

UDC 620.193.46

CORROSIVE AND ELECTROCHEMICAL BEHAVIOR OF LOW NICKEL-MOLYBDENUM Ti-Mo-Ni ALLOYS OF TITANIUM IN ACIDIC CHLORIDE SOLUTIONS

Moscow ZASHCHITA METALLOV in Russian Vol 18, No 1, Jan-Feb 82
(manuscript received 15 Sep 80, after completion 9 Mar 81) pp 62-65

TOMASHOV, N. D., SKVORTSOVA, I. B., KAZARIN, V. I., GONCHARENKO, B. A. and MIKHEYEV, V. S., Institute of Physical Chemistry and Institute of Metallurgy, USSR Academy of Sciences

[Abstract] The behavior of titanium alloys with a low molybdenum and nickel content in hot acidified chloride solutions was studied for the purpose of determining the effect of sea water on the corrosion resistance of desalination equipment. Four series of specimens were tested: Mo:Ni = 3:1 (0.3-9% Mo, 0.1-3% Ni), Mo:Ni = 1:3 (0.2-0.6% Mo, 0.6-2% Ni), 0.9% Mo + n%Ni ($0.0 \leq n \leq 4$), n%Mo+ 2%Ni ($0.0 \leq n \leq 4$). They were tested for 100 hours at 100°C in 2 N NaCl solutions with HCl added to make the pH equal to 0.5, 0, -0.3 respectively. All alloys were found to be corrosion resistant (with a corrosion rate below 0.01 $g/m^2 \cdot h$) in pH = 0.5 solutions. Those with a total alloy content above 2% were found to be still corrosion resistant (with a corrosion rate slightly above 0.01 $g/m^2 \cdot h$) in pH = 0 solutions, with a higher nickel content being preferable in this case. The corrosion rate was found to become somewhat higher in pH = -0.3 solutions and here, according to the polarization curves, addition of molybdenum would significantly increase the corrosion resistance. The best alloy for service in the thermal desalination process with pH ≈ 0 sea water contains 2% Ni + (0.6-1)% Mo. Figures 2; references 13: 10 Russian, 3 Western.
[71-2415]

UDC 621.794.42:669.295:620.193.41

ACIDIC SOLUTION FOR REMOVAL OF SCALE FROM TITANIUM SURFACE

Moscow ZASHCHITA METALLOV in Russian Vol 18, No 1, Jan-Feb 82
(manuscript received 15 Dec 80) pp 66-68

OKHRAMOVICH, L. N., TOMASHOV, N. D., BURCHUK, L. I., ONASENKO, V. K. and KOVALENKO, A. K., All-Union Scientific Research and Design Technological Institute of the Pipe Industry, Institute of Physical Chemistry, USSR Academy of Sciences

[Abstract] A coating of $NaNO_3$-MgO deposited on titanium before heat treatment forms a porous and friable heterogeneous scale on the titanium surface. A solution has been developed which removes the scale within 40-50 min without etching the surface or causing surface roughness and hydrogenation. It does not dissolve the scale-free metal faster than 5-7 $g/m^2 \cdot min$. The solution consists of ammonium fluoride as the etchant and nitric acid as the passivator. The optimum mix of both components was established on the basis of a planned 3-factorial 3-level mathematical experiment with the HNO_3 concentration X_1 (4, 32, 60 wt.%), the NH_4F concentration X_2 (2, 11, 20 wt.%), and the solution temperature X_3 (20, 40, 60°C). Two process parameters, namely the complete scale removal time Y and the metal corrosion rate in scale-free specimens Y', were optimized through a regression analysis of experimental data. An aqueous solution of (25-32)% HNO_3 and 2% NH_4F should remove, within 3-5 min at 40°C, scale formed on a titanium surface during heat treatment at 730°C for 30 min with a coating which has been deposited before from a 40% $NaNO_3$ + 2% MgO solution at 80°C for 3-4 min. This was confirmed in an actual experiment. Figures 2; references 2: both Russian.
[71-2415]

UDC 620.193.43

CORROSION RESISTANCE OF STEELS AND TITANIUM IN EUTECTIC MELT OF POTASSIUM AND MAGNESIUM NITRATES

Moscow ZASHCHITA METALLOV in Russian Vol 18, No 1, Jan-Feb 82
(manuscript received 9 Mar 81) pp 75-78

NIYGER, F. V., OZERYANAYA, I. N., BEZHENAR, V. P. and MARUSYAK, R. A., All-Union Scientific Research and Design Institute of Halurgy, Kalush branch

[Abstract] An experimental study was made to determine the corrosion resistance at various high temperatures of carbon steel St3, chromium steels (08Kh13, 2Kh13, 3Kh13), plain chromium-nickel steels (1Kh17N2, 0Kh21N5T, 12Kh18N9, Kh18N10T, Kh23N13, Kh23N18), chromium-nickel steels with molybdenum (Kh17N13M2T) and with

manganese (Kh14G14N3T), and titanium VT1-0 in a melt of eutectic KNO_3-$Mg(NO_3)_2$ salt mixture containing impurities such as water, $CaSO_4$ and NaCl. The chemical composition of 50 x 35 x 2 mm specimens corresponded to Government Standard 5632-72, their surfaces were polished to a class-9 finish and degreased. The moisture content in the melt was reduced to its minimum residual level of 0.015 wt.% by heating and scavenging with dry argon for 16 hours at 160°C, 14 hours at 200°C, 12 hours at 220°C, 8 hours at 250°C. Carbon steel was found to be least corrosion resistant (0.12 $g/m^2 \cdot hr$), chromium steels much more (0.03 $g/m^2 \cdot hr$) and chromium-nickel-manganese steel less resistant than chromium steels. The corrosion resistance of chromium steels was found to decrease with increasing carbon content and that of all these steels in the presence of $CaSO_4$ and NaCl in the melt, especially with more than 0.5% NaCl. The corrosion resistance of austenitic chromium-nickel steels is high (below 0.07 $g/m^2 \cdot hr$) even in the presence of impurities, but decreases somewhat with rising temperature. Titanium is extremely corrosion resistant (0.001 $g/m^2 \cdot hr$) and, therefore, along with Kh18N10T steel recommended for equipment operating in a eutectic mixture of nitrates at 190-250°C. Figure 1; references 8: 7 Russian, 1 Western.
[71-2415]

UDC 620.197.5

ELECTROCHEMICAL PROTECTION OF ALUMINUM ALLOYS IN SEA WATER

Moscow ZASHCHITA METALLOV in Russian Vol 18, No 1, Jan-Feb 82
(manuscript received 18 Mar 81) pp 106-107

BAKULIN, A. V.

[Abstract] A study of Al-Mg (AMg61) and Al-Zn-Mg (V92ts) aluminum alloys in a stream of sea water has confirmed the effectiveness of cathodic polarization in preventing contact corrosion as well as season cracking and parting. It does not effectively inhibit crevice corrosion, however, which plays the principal role in the parting process. Even weak anodic polarization, on the other hand, may be sufficient to initiate parting or pitting. After such a corrosion has begun, cathodic polarization will not prevent its propagation. It is recommended, therefore, that the preventive cathodic polarization process be periodically interrupted without resorting to anodic polarization for the avoidance of metal dissolution. References 4: all Russian.
[71-2415]

UDC 620.193.27

DESTRUCTION AND PROTECTION OF ALUMINUM ALLOY IN STREAM OF SEA WATER

Moscow ZASHCHITA METALLOV in Russian Vol 18, No 1, Jan-Feb 82
(manuscript received 13 Apr 81) pp 107-111

BAKULIN, A. V. and PODGORNYY, Yu. I.

[Abstract] Destruction of aluminum-alloy ship structures in rapid streams of sea water is regarded as a nonadditive combination of various processes, principally cavitation and hydroerosion. The effective destruction rate and the necessary cathodic protection of AMg61 specimens were measured in a flow-test pipe channel with sea water either still or moving at a velocity of 50 m/sec. An evaluation of electrical data in the form of polarization curves and hydromechanical data on the basis of similarity analysis reveals that hydroerosion of this aluminum-magnesium alloy in a rapid stream of sea water can be eliminated by a shift of the protective potential from -0.9 V in still sea water toward -1.35 V, depending on the stream velocity, or to -1.5 V for overprotection. Figures 3; references 9: 7 Russian, 2 Western.
[71-2415]

GLASS AND CERAMICS

UDC: 669.784:539.1.04

PHYSICAL-CHEMICAL, MECHANICAL AND VACUUM PROPERTIES OF CARBON GLASS CERAMIC AND EROSION OF ITS SURFACE UPON BOMBARDMENT WITH HYDROGEN AND HELIUM IONS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov-Dec 81
(manuscript received 22 Jan 79) pp 30-39

PLESHIVTSEV, N. V., VIRGIL'YEV, Yu. S., VOLKOV, G. M., GUSEV, V. M. [deceased], GUSEVA, M. I., ZAKHAROVA, Ye. N., KALUGIN, V. I., MASLENNIKOV, Ye. A., MIRNOV, S.V. and ORLOV, P. N., Moscow

[Abstract] Carbon glass ceramics ["Uglesitalls"] are a new class of carbon materials, with or without various quantities of alloying elements, of great interest as possible materials for first wall construction is thermonuclear reactors. This paper compares the strength, elasticity and hardness properties of USB-15 carbon glass ceramic with electrolytic graphite and pyrolytic carbon. A photomicrograph is presented of a fracture surface of the material. USB-15 is found to be a high temperature, high strength, chemically stable carbon material with low rates of chemical and physical erosion and a relatively low atomic number, making it very promising as a material for thermonuclear and hybrid reactor construction. The new material has a number of unique properties indicating its promise for extensive utilization in various areas of modern science and technology including power engineering, machine building, metallurgy, chemistry and medicine. USB-15 consists of carbon + boron, but the exact composition is not given. It has been used to manufacture a diaphragm for the T-4 tokamak. The material can be worked by ordinary lathes, milling machines, drilling and grinding machines with standard cutting tools, and has a very low coefficient of friction when lubricated by water or gas. It is manufactured as 100 x 200 mm plates up to 10 mm thick and tubes up to 200 mm in length, outside diameter up to 150 mm and wall thickness up to 10 mm. It can also be applied to molybdenum alloys. References 40: 26 Russian, 14 Western.
[59-6508]

POWDER METALLURGY

UDC: 669.295

PROCESSING OF SODIUM-REDUCED REACTION MASS INTO TITANIUM POWDERS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 1, Jan 82
(manuscript received 20 May 81) pp 4-8

ALEKSANDROVSKIY, S. V., BERDNIKOVA, L. M., LUKASHENKO, G. S., PINAYEV, Ye. N.
and SNISAR', G. P., Leningrad Institute of Mining

[Abstract] Sodium-reduced titanium chlorides form a reaction mass of heterogeneous composition. Pilot-scale installations were used to study dry and wet grinding of this reaction mass. In order to improve the output of the grinding process, conditions of labor and yield of high quality metal, a study was made of grinding powders after leaching. A ball mill was used, and the optimal material/balls ratio was found to be 1:3. Titanium powders produced by wet grinding were found to have less residual chlorine ion than powders produced immediately after leaching in an agitator. The positive influence of wet grinding on chlorine ion content results from the fact that during grinding the primary structure of the metal is broken down, opening isolated pores and extracting additional chlorides by extending the leaching time. The end product produced was dry titanium powder 0.18-0.16 mm in diameter and a moist powder less than 0.18 mm in diameter. Figures 2; references 4: all Russian.
[74-6508]

UDC: 621.762

STRENGTH OF ZIRCONIUM CARBIDE BASED COMPOSITES WITH DISPERSED CARBON INCLUSIONS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 1, Jan 82
(manuscript received 9 May 80) pp 67-74

GERASIMOV, P. V., YEGOROV, V. S., LANIN, A. G., NEZHEVENKO, L. B. and
SOKOLOV, V. A., Podol'sk

[Abstract] A study is made of the strength, thermal stability and fracture toughness of zirconium carbide-carbon composite materials with a carbon component consisting of particles of synthetic diamond as a function of the quantity and

diameter of the carbon inclusions in the 20 to 1800°C temperature range. The strength characteristics of composites with other carbon components were also compared. The composites were prepared by mixing of powders ground to a surface of $2.5\text{-}3.0 \cdot 10^3$ m^2/kg and synthetic diamond with particle sizes of 0.2 to 50 μm, dry pressing, and sintering in argon at 2600°C for 1 hour after heating at 200-300° C/hr. Other carbon materials included natural flake graphite and artificial graphite. It was found that the introduction of 0.2-6 μm carbon particles resulted in variable strength, fracture toughness and thermal stability changes in the composites, with the maximum at around 2.5 mass %. Larger carbon particles decreased strength characteristics with increasing carbon content. Synthetic diamond and artificial graphite increased thermal stability; natural flake graphite decreased thermal stability. Figures 4; references 8: 6 Russian, 2 Western.
[74-6508]

UDC: 621.763:539.214

STRESS-STRAIN STATE OF POROUS COMPOSITE MATERIALS UNDER COMPRESSION

Kiev POROSHKOVAYA METALLURGIYA in Russian No 1, Jan 82
(manuscript received after revision 2 Oct 80) pp 84-88

MANUKYAN, N. V., PETROSYAN, G. L., MINASYAN, B. Ts. and PETROSYAN, A. S.,
Yerevan Polytechnical Institute

[Abstract] A study is made of the selection of the final deformation processing of a composite material as a function of the mass and geometric dimensions of the material as well as the mechanical properties of porous blanks and, consequently, their stress-strain state in the compacting process. A charge consisting of a mixture of a metal powder matrix and randomly oriented fibers was subjected to static pressing then sintering in hydrogen at 1150°C for 3 hours. The mechanical characteristics were then determined. The results of testing of the porous composite materials in monaxial compression were processed by the theory of the plasticity of porous bodies and deformation diagrams were constructed, based on which an approximate solution was produced to the problem of compacting the porous composite material in rigid dies. Figures 2; references 4: 3 Russian, 1 Western.
[74-6508]

UDC: 621.762.5.001:539.4.42:620.18

SPECIFICS OF SHAPE MEMORY EFFECT IN POROUS NICKEL-TITANIUM MATERIAL

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12, Dec 81
(manuscript received 15 Jan 81) pp 41-45

MARTYNOVA, I. F., SKOROKHOD, V. V. and SOLONIN, S. M.,
Institute of Material Science Problems, Ukrainian Academy of Sciences

[Abstract] A study was made of the possibility of implementing the shape memory effect in a porous material produced by sintering of a mixture of nickel and titanium powders with a volatile pore former. Cylindrical specimens were produced by pressing and sintering of a mixture of 55 mass % carbonyl nickel and 45 mass % calcium hydride titanium in a vacuum at 1000°C for 4 hours. The resulting porosity of the specimens was 30 to 70%. Completeness of recovery of the shape when deformed porous titanium nickelide is heated is less than for nonporous intermetallides. As the initial porosity increases, the completeness of shape recovery increases for the same degree of deformation. The degree of reversible deformation for highly porous titanium nickelide is equal to that of nonporous nickel-titanium intermetallide and the degree of permissible macroscopic preliminary deformation for the porous materials is significantly greater. Figures 3; references 4: 3 Russian, 1 Western.
[60-6508]

UDC: 669.719+536.46

INFLUENCE OF OXIDATION OF TITANIUM POWDERS ON SYNTHESIS OF TITANIUM CARBIDE BY SVS METHOD

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12, Dec 81
(manuscript received 11 Feb 81) pp 49-54

SHKIRO, V. M., PROKUDINA, V. K. and BOROVINSKAYA, I. P.,
Institute of Chemical Physics, Ukrainian Academy of Sciences

[Abstract] Titanium powders produced by various methods were used to study the influence of the content of impurity oxygen and specific surface of the powders on the chemical composition of the titanium carbide synthesized, the completeness of the chemical transformation and the rate of propagation of the wave of synthesis (combustion). Studies were performed on laboratory and pilot-scale installations. The variation in rate of combustion is determined both by the particle size of the titanium powder and by the quantity of dissolved oxygen. The completeness of chemical conversion, quality of the product produced and its purification from oxygen are related for synthesis of titanium carbide from titanium powders

contaminated with oxygen to the specifics of the mechanism of interaction of titanium with carbon in the combustion wave. Another important factor influencing the quality of the titanium carbide produced in the pilot-scale is that after the combustion wave passes the excess pressure of the gases formed is released rapidly and cooling of the product occurs with constant evacuation of the reactor. Figures 2; references 18: all Russian.
[60-6508]

UDC: 620.18:62-419:677-15

INFLUENCE OF BARRIER COATING OF TITANIUM CARBIDE ON INTERACTION OF CARBON-ALUMINUM COMPONENTS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12, Dec 81
(manuscript received 10 Feb 81) pp 55-59

ZABOLOTSKIY, A. A., TREFILOV, B. F., IGNATOVA, N. P. and KOT, Yu. D., Moscow

[Abstract] A study was made of the influence of coatings of titanium carbide on the interaction of carbon-aluminum components obtained by forced saturation. The initial materials used were carbon fiber without coating and with a barrier TiC coating with a strength of about 2500 MPa and elasticity modulus 500 GPA, as well as AL9 aluminum alloy. Coatings were applied by precipitation from a gas mixture of titanium tetrachloride and methane. For composite materials with fibers coated with TiC, heat treatment for 30 and 100 hours did not change the mechanical characteristics. The results indicate a significant increase in thermal stability by the use of reinforcing fibers coated with titanium carbide. The status of material changes significantly. There is a transition from the optimal status of fracture with breaking of fibers to a status with degree of interaction $S=+0.2$. Fractographic study of composite specimens with uncoated fibers showed that the fracture surface is well-developed, while in specimens treated at 500°C the size of transverse cuts is increased and the number of longitudinal cuts and layer separations is decreased, indicating the predominance of brittle fracture. Coatings of titanium carbide improve the compatibility of the fibers and the matrix and give the material elevated thermal stability. Figures 6; references 5: 4 Russian, 1 Western.
[60-6508]

UDC: 621.762

INTERNAL FRICTION AND EFFECTIVE MODULUS OF ELASTICITY OF POROUS AND FILLED COMPOSITE MATERIALS BASED ON COPPER, NICKEL AND MOLYBDENUM

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12, Dec 81
(manuscript received 15 Jan 81) pp 76-80

ZOLOTUKHIN, I. V., TRUSOV, L. I., KALININ, Yu. Ye., LAPOVOK, V. N.,
YAKOVLEV, G. A., GELEYSHVILI, T. P. and SUKHODOLOV, B. G.,
Voronezh Polytechnical Institute

[Abstract] A study was made of the spectrum of attenuation of mechanical oscillations at audio frequency and of the effective elasticity modulus of porous and filled light alloy metals and alloys of materials based on nickel, copper and molybdenum. It was shown that the introduction to the pores of the matrix of low-melting metals and alloys increases the effective elasticity modulus. It is established that a high level of internal friction near the melting points of the metals and alloys introduced to the pores results in viscoelastic processes at the grain boundaries and phase separations. The process of formation of inter--metallides of nickel and tin on diffusion of liquid tin in contact with the nickel in the pores is studied. The possibility is shown of creating materials with assigned effective elasticity modulus. The isothermal HT $Q^{-1}(t)$ of nickel saturated with an Sn-Pb eutectic decreases with the passage of time and allows tracking of the formation of Ni-Sn intermetallides. Figures 5; references 12: 11 Russian, 1 Western.
[60-6508]

UDC: 621.762

GLASS FOR COMPACTING TITANIUM ALLOYS BY GAS-STATIC PRESSING

Kiev POROSHKOVAYA METALLURGIYA in Russian No 1, Jan 82
(manuscript received 7 Jan 81) pp 98-100

BUTAYEVA, V. I., OZEROVA, L. D., VYGORKA, N. M. and GRIGOR'YEV, A. I., Obninsk

[Abstract] A new method of compacting powders using vitrified capsule envelopes has the advantage that during cooling after isostatic pressing the envelope loses plasticity and shrinks, causing the development of tensile stresses, cracking and self-separation. The materials of the capsule must be chemically inert. An alkaline aluminoborosilicate glass system was selected to synthesize glass compositions for testing. Experimental melts of glass were produced in the crucible furnace in quartz crucibles of 3-4 ℓ capacity, larger batches for industrial use in a bath furnace by a batch method. Figure 1; references: 1 Russian.
[74-6508]

UDC: 621.724

DESIGN OF DIES REINFORCED WITH HARD ALLOYS FOR CALIBRATION OF SINTERED PRODUCTS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 1, Jan 82
(manuscript received 29 Oct 80) pp 100-105

KHERSONSKIY, A. K., Tashkent

[Abstract] A method is presented for calculating the optimal geometry of a matrix to be used to surround hard alloy inserts for cold upsetting, reducing, drawing, etc. The additional capabilities for strengthening of hard alloy tools by heat treatment are studied. The author has developed a method for strengthening hard alloy dies by hardening in a gas medium with compression of the surface layer under a stress similar to that obtained by placing a rim around the tool. The method can increase strength and improve usage characteristics while decreasing the dimensions of tools. Equations are obtained for calculating the optimal parameters of rims for hard alloy tools. The results have been applied in the development of pressed tools for Tashsel'mash Machine Plant.
References 5: all Russian.
[74-6508]

STEELS

UDC: 669.15-194.56:620.17

MECHANICAL PROPERTIES OF AGING AUSTENITIC STEELS AT LOW TEMPERATURES

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 6, Nov-Dec 81 (manuscript received 27 Feb 81) pp 130-134

KABLUKOVSKAYA, M. A., BLINOV, V. M. and BANNYKH, O. A., Moscow

[Abstract] A study was made of the structure and mechanical properties of +20 and -196°C of two aging austenitic steels after various heat treatments. The chemical composition of the steel was selected so that the matrix was stable with respect to γ-α conversion of austenite when heated to 1200°C and cooled to -253°C, while the hardening phase consisted of vanadium carbide. The steel types used were 40G20N13F and 40Kh14G14N10F. Chemical compositions were as follows:

	C	Mn	Ni	Cr	V	Si	S	P
40G20N13F	0.39	20.64	12.50	-	0.91	0.36	0.008	0.006
40Kh14G15N10F	0.34	16.00	9.6	14.6	1.00	0.39	0.009	0.011

Optimal conditions of heat treatment of nonmagnetic aging vanadium-containing steels were produced to increase the strength and ductility at room and low temperatures. Type 40G20N13F steel after hardening from 1100°C and aging at 650°C for 10 hours had a yield point of 80-110 kgf/mm^2. Stainless steel 40Kh14G15NTF after hardening from 1150°C and aging for 10 hours at 650°C had a yield point of 65-120 kgf/mm^2 and can be used for nonmagnetic highly loaded parts for low temperature equipment. Figures 4; references 3: all Russian.
[65-6508]

SUPERHARD MATERIALS

UDC: 621.941.025

CARBONITE: NEW SUPERHARD POLYCRYSTALLINE MATERIAL

Kiev SVERKHTVERDYYE MATERIALY in Russian No 6, Nov-Dec 81
(manuscript received 15 May 81) pp 11-12

GERASIMENKO, V. K., BESPAL'KO, O. P., BONDARENKO, V. P. and BEZHENAR', N. P., Kiev, Institute of Superhard Materials, Ukrainian Academy of Sciences

[Abstract] The Institute of Superhard Materials in cooperation with the Institute of Physical Chemistry, USSR Academy of Sciences, has created a new polycrystalline material called carbonite. It is obtained from synthetic diamond powder with a special coating at high pressures and temperatures corresponding to the area of thermodynamic stability of diamond. A technology has been developed for production of the material in the form of compact cylindrical products 3.0-7.0 mm in diameter and 3.0-5.5 mm high. The microhardness of the material is 39.2-44.2 GPa, compressive strength 4.42-5.88 GPa, strength after heating for 20 minutes to 1200°C in hydrogen 2.94-3.92 GPa. Photographs of specimens are presented. The material is best used for turning of aluminum and copper alloys. Figures 1.
[73-6508]

UDC: 549.08:548

POLYHEDRAL GROWTH FORMS OF CUBIC BORON NITRIDE CRYSTALS

Kiev SVERKHTVERDYYE MATERIALY in Russian No 6, Nov-Dec 81
(manuscript received 27 Apr 81) pp 6-11

SHUL'ZHENKO, A. A., VISHNEVSKIY, A. S., SOKOLOV, A. N. and PETRUSHA, I. A., Kiev, Institute of Superhard Materials, Ukrainian Academy of Sciences

[Abstract] The Institute of Superhard Materials has developed boron nitride crystals with a high spatial form factor with characteristic trigonal-tritetrahedral habitus. The simple forms of the crystals were analyzed by geometric crystallography, the symbols of the faces determined by measurement performed on a goniometer. The crystals were synthesized under conditions of spontaneous mass

crystallization from a multicomponent reaction composition at high static pressures and temperatures. Photomicrographs of multifaceted crystals are shown, produced by reflected electron microscopy. It was found that synthesis parameters significantly influence the kinetics and mechanism of crystal growth, determining their defect content and face relief. Figures 6; references 13: 10 Russian, 3 Western.
[73-6508]

THERMOMECHANICAL TREATMENT

UDC: 621.385.79:669.2955'24

INFLUENCE OF THERMOMECHANICAL TREATMENT ON SHAPE MEMORY EFFECT OF TN-1 ALLOYS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov-Dec 81
(manuscript received 10 Nov 79) pp 67-70

ANTIPOV, A. I., MATLAKHOVA, L. A., ZHEBYNEVA, N. F. and OLEYNIKOVA, S. V., Moscow

[Abstract] A study is made of the relationship between the degree of shape restoration of specimens due to "shape memory" and the structural state of materials. Conditions of thermomechanical treatment of TN-1 alloy semifinished goods are selected to achieve at least 80% shape memory for 100 test cycles with various combinations of loads. This is achieved by deforming the material cold by 30% and assuring that the material has a β phase structure. With loads of up to 90 MPa this condition can be met by a material deformed with a degree of compression up to 5% or over 25%, which achieves the M and β+(M) structures, respectively. Figures 3; references 4: 3 Russian, 1 Western.
[59-6508]

UDC: 669.15'24'26-194:548.7

STRUCTURE AND PROPERTIES OF MARTENSITE AGING STEEL AFTER THERMOMECHANICAL AND REPEATED HEAT TREATMENT

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 6, Nov-Dec 81
(manuscript received 28 Jul 80) pp 107-114

BERNSHTEYN, M. L., KAPUTKINA, L. M., PROKOSHKINA, V. G., VARGANOV, V. A., KRIVONOGOV, G. S. and KLYUCH, A. S., Moscow

[Abstract] The purpose of this work was to study the relationship between the structural characteristics and mechanical properties of martensite-aging stainless steel type VNS-2 after high temperature thermomechanical treatment and repeated heat treatment. Plates were heated to 1160 or 1050°C and rolled at that temperature or at 950°C in one or three passes with immediate multistage cooling (in water until the surface darkened, then in air). The degree of compression varied from 20 to 70%. Rehardening was performed after heating to 1000°C, holding for

45 minutes. Hot deformation was found to have a significant influence on the structure and properties of the steel. The optimal combination of mechanical properties was achieved with the maximum deformation. This is a result of the favorable combination of direct heredity of the polygonized structure of the austenite by the martensite crystals, a decrease in dimensions and an increase in homogeneity of the martensite crystals, breakup of the austenite grain upon partial recrystallization and more uniform segregation of copper upon aging. The effect of improved mechanical properties can be preserved upon brief heating if the retreatment is not performed at extremely high temperatures. Figures 4; references 7: 2 Russian, 5 Western.
[65-6508]

UDC: [669.018.95-416:539.234]:
621.316.8.028.3-416

CHANGES IN COMPOSITION OF MULTICOMPONENT THIN FILMS OF MLT-14 ALLOY IN PROCESS OF PRECIPITATION

Minsk IZVESTIYA AKADEMII NAUK BSSR: SERIYA FIZIKO-TEKHNICHESKIKH NAUK in Russian
No 4, Oct-Dec 81 (manuscript received 27 Oct 80) pp 43-46

GERMANOVICH, V. I., RAKOVA, N. A., ROSSINSKIY, V. A. [deceased] and CHAPLANOV, A.M.,
Institute of Electronics, Belorussian Academy of Sciences

[Abstract] A study was made of the variation in the composition of thin films of MLT-14 alloy as a function of precipitation conditions. Composition of initial alloy (mass %) was: CeO_2 - 45; Si - 33.5; Cr - 8; Al - 4.3; W - 9.2. Specimens were produced in a standard installation used in the production of MLT resistors by precipitation onto a teflon-type substrate moving at 0.5 cm/sec. The specimens were studied in a scanning electron microscope. Curves of the change in composition of alloy films with increasing evaporation time show clear precipitation speed maxima for all components of the alloy during the process of evaporation. The content of silicon and chromium in the films was significantly higher, aluminum about one half and cerium about one third of the content in the initial specimen. To make the composition of precipitated films close to the initial composition, higher evaporation temperatures must be used by increasing the evaporator current and the length of the evaporation cycle, and a mechanism capable of cutting off the flow of evaporated substance must be available to cut off a portion of the precipitation cycle. Figures 1; references 3: all Russian.
[58-6508]

UDC: 620.18:620.186.4:669.295.5

INFLUENCE OF STRUCTURE ON CRACK RESISTANCE OF VT3-1 ALLOY

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian
No 12, Dec 81 pp 33-34

TOMSINSKIY, V. S., SHISHKINA, M. I., BEZRUKOVA, A. K. and IVANOV, A. S.

[Abstract] An estimate is made of the influence of heating temperature before rolling on the structure, mechanical properties and crack resistance of VT3-1 titanium alloy. Blanks consisting of bars 40 mm in diameter with initial globular structure were rolled at 900, 950, 1000 and 1050°C with 20, 40 and 60% compression in 2, 4 and 6 passes without intermediate reheating and cooling in air. The specimens were then annealed at 900°C for 9 hours, 550°C for 2 hours and cooled in air. The structure, mechanical properties and crack resistance of the alloy were studied in the deformed and annealed states. The results showed that depending on the rolling conditions a structure is formed which differs not only in its form but also the internal structure of the α phase particles. Annealing at 900°C for 3 hours, 550°C for 2 hours and cooling in air significantly increases the fracture resistance of VT3-1 alloy by spheroidization and enlargement of α phase particles in the globular structure and increasing the distance between them and by significantly reducing the dislocation density in the α phase both in the alloy with globular structure and in the alloy with plate structure. Figures 1; references 3: all Russian.
[63-6508]

UDC: 620.17:620.18:669.295.5

SELECTION OF OPTIMAL PROCESSING OF TITANIUM PSEUDO α-ALLOYS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian
No 12, Dec 81 pp 34-36

GOSTEVA, L. V., DANILINA, O. B., NATAPOV, S. L. and PLATONOV, V. M.

[Abstract] Work was performed on comparison of the mechanical properties and structure of various semifinished goods of OT4, OT4-1, VT20 and VT6S alloys after hot deformation and after deformation and annealing. Studies were performed on bars, large and small forgings, stampings, plates, tubes and cylinders. The data produced indicated that in the process of cooling of the semifinished goods with cross sections of 40 to over 100 mm in air, recovery processes occur: dynamic recrystallization and dynamic recovery, due in part to the slow cooling resulting from the low heat conductivity of titanium. For parts of VT20 alloy made from bars, forgings and stampings, annealing was noted. The semifinished goods were subjected to final acceptance testing of mechanical properties. Semifinished goods of VT6S alloy and OT4-1 alloy have the same properties in the hot deformed state as after annealing. Eliminating annealing from many semifinished goods of pseudo α-titanium alloys can result in great economic savings. Figures 1; references 2: both Russian.
[63-6508]

UDC: 620.17:669.295.5

THERMAL STABILITY OF PSEUDO α-TITANIUM ALLOYS AND METHODS OF ITS ESTIMATION

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian
No 12, Dec 81 pp 37-39

ZHUKOV, V. A., IVANOVA, L. A., MARINETS, T. K., RAZUVAYEVA, I. N. and KHESIN, Yu.D.

[Abstract] The purpose of this work was to select and develop a foundation for a method allowing the results of mechanical testing to be used to detect the early stages of decomposition of the α solid solution in α and pseudo α alloys of titanium. Low-cycle testing of notched specimens in a corrosive medium in flexure with a pulsating loading cycle was selected. The correctness of estimation of the thermal stability of the titanium alloys in a given temperature interval depends to a great extent on the method of investigation. Studies of the kinetics of reduction in low cycle durability after aging of notched specimens with at least 6% aluminum content can reveal the early stages of breakdown of the α solid solution: formation of microsegregations, enrichment with alloying elements (primarily aluminum) and variations in electrochemical potential. Figures 1; references 10: 8 Russian, 2 Western.
[63-6508]

UDC: 620.111.3:669.295.5

STUDY OF METASTABLE TRANSFORMATIONS IN TITANIUM ALLOYS BY MEASUREMENT OF ACOUSTICAL CHARACTERISTICS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian
No 12, Dec 81 pp 39-41

MOISEYEV, V. N., KOSARIN, A. G., CHUGUNOV, M. I. and ZNAMENSKAYA, Ye. V.

[Abstract] The acoustical properties of the structural components of industrial titanium alloys of various types were studied: VT5-1 with α structure, OT4-1 pseudo α alloy, VT16 with $\alpha+\beta$ structure of martensite type and VT22 with $\alpha+\beta$ structure of transient type. The specimens were disks 20 to 70 mm in diameter and 15-25 mm high with irregular ends. The alloys were studied in the annealed state and after hardening and aging. Stable α and β solutions, their mixtures with various ratios of α and β phases and metastable states were thus all tested. A method of measurement of acoustical characteristics was found to be usable not only for studies of the structure, but also for determination of the phase composition of titanium alloys. The ultrasonic oscillation attenuation factor and propagation velocity of ultrasonic P waves in titanium alloys are determined by the degree of stability of the β phase, as well as the α'' and ω phases. Figures 3.
[63-6508]

UDC: 621.762.2+541.052

INTENSIFYING PROCESS OF DISPERSION OF TITANIUM

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12 Dec 81
(manuscript received 25 Feb 81) pp 1-5

IL'INA, Z. T., BRYK, M. T. and NADEL, L. G., Institute of Colloids Chemistry and the Chemistry of Water, Ukrainian Academy of Sciences; Institute of Materials Science Problems, Ukrainian Academy of Sciences

[Abstract] The purpose of this study was to develop a method of intensification of the process of dispersion and modification of the surface of titanium powder while using oligomers of various types as the dispersion agents. The studies were performed on polyaluminoethylsiloxane, type ED-20 epoxy resin and coarsely dispersed titanium with specific surface 0.2 m^2/g. The titanium was dispersed in a planetary mill consisting of four containers with a volume of 100 cm^3 each filled with steel balls 3-8 mm in diameter and rotating at 1400-2000 rpm around their axes and 400-1000 rpm around the main axis of the mill. The coarsely dispersed titanium was treated with 2-20 g epoxy resin or PAES for 30 minutes to 5 hours. The optimal conditions for intensifying dispersion of titanium using organosilicon

oligomers with high specific surface (20-30 m^2/g) were determined to be approximately 2 hours' grinding time with approximately 10 g oligomer per 100 g titanium powder present. Figures 3; references 11: 8 Russian, 3 Western.
[60-6508]

FORMATION OF METASTABLE BETA PHASE IN VT15 PRESSED TITANIUM ALLOY UPON RAPID ELECTRIC HEATING

Minsk IZVESTIYA AKADEMII NAUK BSSR:SERIYA FIZIKO-TEKHNICHESKIKH NAUK in Russian No 4, Oct-Dec 81 (manuscript received 18 Nov 80) pp 30-35

BODYAKO, M. N., GORDIYENKO, A. I. and DYMOVSKIY, A. S., Physico-Technical Institute, Belorussian Academy of Sciences

[Abstract] Results are presented from a study of the influence of rapid electrothermal processing on the structure and mechanical properties of pressed VT15 alloy containing 2.7% Al, 7.2% Mo, 10.1% Cr, 1.2% Ar, 0.15% Fe, 0.12% Si, 0.01% O_2, 0.03% N_2, 0.001% H_2. Sections 12 mm in diameter and 100 mm in length were cut from blanks produced from pressing at 1050°C, then heated in an electric contact installation at 100°C/sec to 700-1200°C with subsequent cooling in water and in air. Some specimens were also heated in a furnace to 700-950°C, held for one half hour, then quenched in water. X-ray diagrams were taken to determine the lattice parameter and phase composition. The use of high speed electric heating after pressing in the β area was found to improve the mechanical characteristics of the alloy in the hardened state. Figures 2; references 10: 8 Russian, 2 Western.
[58-6508]

UDC: 620.178.311.6

EXPERIMENTAL STUDY OF DAMPING PROPERTIES OF VT3-1 AND VT8 ALLOYS WITH LAYERED METAL COATINGS

Kiev PROBLEMY PROCHNOSTI in Russian No 12, Dec 81
(manuscript received 22 Jun 80) pp 63-66

YAKOVLEV, A. P. and ROYTMAN, A. B., Institute of Strength Problems, Ukrainian Academy of Sciences, Kiev, Zaporozh'ye

[Abstract] The purpose of this work was to study the effective application of layered electrolytic metal coatings to increase the damping properties of specimens made of VT3-1 and VT8 alloys. The damping capacity of the specimens was studied by a method developed at the Institute of Strength Problems, Ukrainian Academy of Sciences in the temperature range of 20 to 250°C. The level of oscillation

decrement of the specimens with the coatings was measured and found to be higher than that of specimens without coatings. These alloys have extremely low natural damping properties, resulting in the possibility of high vibration stress on structural elements made of them. The application of coatings containing electrolytically deposited copper, nickel, chromium and an enamel with a total thickness of 90 to 130 micrometers produced an increase in the damping characteristics. With otherwise equivalent conditions, preference should be given to 4-layer coatings with a total thickness less than competing 3-layer coatings. [61-6508]

UDC: 669.295:621.785.532

KINETICS OF NITRIDING AND WEAR RESISTANCE OF TITANIUM ALLOYS

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 6, Nov-Dec 81 (manuscript received 10 Nov 80) pp 172-177

SHASHKOV, D. P., VINOGRADOV, A. V. and POLOKHOV, V. N., Moscow

[Abstract] Pure titanium of type VT1-0 α+β titanium alloy type VT22 and a metallic compound NiTi, 54% Ni and 46% Ti were studied. In order to determine the most effective method of chemical and heat treatment to increase surface hardness, various methods of surface hardening were tried: carburization, galvanic and diffusion chrome plating and nitriding in pure nitrogen, ammonia and nitrogen with propane or methane. It was found that the most effective method of surface hardening was nitriding in pure ammonia with 30-40% dissociation. The distribution of microhardness through the depth of the nitrided layer showed that the greatest increase in surface hardness occurs in the metallic compound NiTi, its nitriding temperature being significantly lower (500°C) than that of the titanium and VT22 alloy (900-1000°C). Tests showed that wear resistance after nitriding was several orders of magnitude higher in NiTi than in pure titanium or VT22 alloy.
Figures 4; references 4: all Russian.
[65-6508]

WELDING

UDC: 621.791.754'293.011:669.295

SPECIFICS OF WELDING AT2 TITANIUM ALLOY

Kiev AVTOMATICHESKAYA SVARKA in Russian No 11, Nov 81
(manuscript received 2 Jul 81) pp 47-49

BLASHCHUK, V. Ye., candidate of technical sciences and GUREVICH, S. M., doctor of technical sciences, Institute of Electric Welding imeni Ye. O. Paton, Ukrainian Academy of Sciences

[Abstract] A study is presented of the weldability of type AT2 alloy and the mechanical properties of its joints produced by both mechanized and manual argon-arc welding. Tests were performed on specimens manufactured of hot rolled sheets of AT2 alloy 1, 3 and 8 mm thick. The mean composition of the alloy was, %: Zr 2.4, Mo 1.4, Al 0.28, Fe 0.035; Si 0.13, [O] 0.10, [H] 0.005, [N] 0.04. It was found that an increase in the oxygen content from 0.1 to 0.15-0.20% increases the strength at 20°K by 2% and decreases ductility by a factor of 3. The impact toughness was determined on notched specimens with a notch through the base metal, seam and zone of thermal influence. At 77-150°K, the strength of AT2 alloy increases greatly, accompanied by an increase in relative elongation. A significant increase in the strength of the seam metal in compaison with the base metal in the same temperature range is explained by the fact that AT2 welding wire was used. The relative elongation of the seam metal, however, was lower than that of the base metal and remained practically unchanged as the temperature dropped through this range. An increase in notch sensitivity factor was also observed with decreasing temperature both in the base metal and in the seam. The alloy and seam metal have good impact toughness, 123 and 111 J/cm^2 at 293°K, 131 and 90 J/cm^2 at 213°K, 111 and 83 J/cm^2 at 77°K. Annealing at 923°K for 30 minutes greatly increases the ductility of the seam metal, while leaving the strength virtually unchanged and decreasing impact toughness, particularly in the low temperature area.
[54-6508]

UDC: 621.791.755

THERMAL BALANCE OF MICROPLASMA REVERSE POLARITY ARC DURING WELDING OF THIN SHEET ALUMINUM ALLOYS

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 11, Nov 81 pp 2-4

ISKHAKOV, G. G., engineer, GAPCHENKO, M. N., doctor of technical sciences, and FESAN, V. P., engineer, Kiev Polytechnical Institute imeni the Fiftieth Anniversary of the Great October Socialist Revolution

[Abstract] A method has been developed of cathode cleaning during reverse polarity microplasma arc welding, allowing both cathode cleaning and simultaneous breakdown of the oxide film and melting of the base metal to be achieved. This method allows simple equipment to produce a stable and controllable plasma arc which can be increased to as much as 4 mm or more in length, and produces a concentrated source of heat with minimal mobility of the cathode spot. Experiments were performed on plates measuring 120 x 40 x 0.8 mm in pure argon and in argon mixed with helium. As a result the optimal conditions were found: current 20 A, welding speed 30 m/hr, arc length 2 mm, nozzle diameter 1.5 mm, protective gas and cooling water flow 2.2 and 0.8 ℓ/min, electrode diameter 1.5 mm. A diagram of the installation used is presented. Figures 4; references 5: all Russian.
[57-6508]

UDC: 621.791.052:539.4:621.09.785.3

IMPROVING PROPERTIES OF WELDED JOINTS IN VT9 ALLOY BY LOCAL HEAT TREATMENT WITH ELECTRON BEAM

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 11, Nov 81 pp 19-20

LYASOTSKAYA, V. S., candidate of technical sciences, LYSENKOV, Yu. T., BIRYUKOV, I. M., OVCHINNIKOV, V. V. and BIBIKOVA, Ye. Ye., engineers

[Abstract] A study was made of the influence of local heat treatment with an electron beam on the structure and properties of welded joints of refractory two-phase type VT9 titanium alloy. Metallographic studies and x-ray structural analysis were performed. Local heat treatment with an electron beam at 800°C for 90 seconds resulted in the formation of small light colored segregations of recrystallization α phase in the welded seam, located against a background of thin plates representing the dispersed products of breakdown of the nonequilibrium structure formed after welding. Local heat treatment at 900°C, 90 sec improves the impact toughness, long-term strength and fatigue limit of the welded joints. Figures 2; references 6: all Russian.
[57-6508]

UDC: 621.791.052:520.18:669.295

INFLUENCE OF VACUUM ANNEALING TEMPERATURE ON EFFICIENCY OF WELDED JOINTS IN TITANIUM STRUCTURES

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 11, Nov 81 pp 28-30

MURAV'YEV, I. I., candidate of technical sciences, KOLOMENSKIY, A. B., ROSHCHUPKIN, A. N., engineers, KOLACHEV, B. A., doctor of technical sciences, SHEVCHENKO, V. V., candidate of technical sciences and TAFINTSEV, Ye. A., engineer

[Abstract] Results are presented from studies of the influence of vacuum annealing at 550 and 660°C for the recommended intervals on certain service characteristics of welded thin sheet joints of the OT4 and OT4-1 alloys. Flat specimens of OT4 0.8 and 2.5 mm thick, and of OT4-1 0.8 mm thick, as well as VT1-0 1.5 mm thick were welded in one pass by an automatic argon-arc welding machine using a tungsten electrode. The specimens were then vacuum annealed at 550 or 660°C for two hours, cooled with the furnace 200°C and tested. The higher annealing temperature resulted in significantly reduced long-term strength in practically all zones of the welded seam. The higher temperature also produced reduced fatigue resistance. This apparently results from the appearance of a gas-saturated brittle layer at the higher temperature, which then serves as a focus for the development of surface cracks. Figures 4; references 6: all Russian.
[57-6508]

UDC: 621.791.4:539.378.3:669.295

DIFFUSION WELDING OF STRUCTURES OF TITANIUM ALLOYS THROUGH FINE-GRAINED INSERT

Kiev AVTOMATICHESKAYA SVARKA in Russian No 11, Nov 81
(manuscript received 8 Apr 81) pp 21-24

GRIGOR'YEVSKIY, V. I., candidate of technical sciences, KARAKOZOV, E. S., doctor of technical sciences (Moscow), RADIONOV, V. N., AKININ, V. K., and VASIL'YEV, V. I., engineers (Voronezh)

[Abstract] A study is made of the specifics of formation of a good quality joint by diffusion welding of elements (thinwall structure fillers of titanium alloys with (large grain plate structure) with a fine-grained intermediate layer (coating). The experiments involved cylindrical specimens 20 mm in diameter and 30 mm long of OT4 and VT14 titanium alloys with a large grained plate structure, butt welded through inserts of the same alloys 0.02 to 120 mm thick but with fine grained equiaxial structure (type A specimens) as well as specimens imitating a honeycomb structure (type B) consisting of a hollow cylinder with wall thickness 0.2-1 mm plus a plate 0.2-4 mm thick. Diffusion welding was conducted at 925° C (VT14) and

950° C (OT4), pressure 0.2-10 MPa, time 20-60 minutes. Type A specimens were tested for impact toughness. Type B specimens were tested by pulling the specimens apart. It is found that optimization of the process of diffusion welding of thinwall structures requires that the relationship of thicknesses of the coating to the cell wall be at least 2.5:1. Figures 5; references 3: all Russian. [54-6508]

KAZAKH MINISTERS CRITICIZED FOR ZHAYREM CONSTRUCTION LAG

Alma Ata KAZAKHSTANSKAYA PRAVDA in Russian 6 Jan 82 p 3

[Unsigned article: "Boost the Tempo and Quality of Construction"]

[Text] The Kazakh SSR Committee of People's Control examined the question of development of the Zhayrem group of deposits of polymetal and iron-manganese ores and noted that the Ministry of Nonferrous Metallurgy and the Ministry of Construction of Heavy Industry Enterprises of Kazakh SSR have been unsatisfactorily fulfilling their targets. Just during the past five-year plan, more than 27 million rubles of capital investment failed to be used in the construction of facilities at the Zhayrem Ore Concentration Plant. Poor use has also been made of funds allocated in the past year. Thus the Zhayremtyazhstroy General Contracting Trust is working at a slow pace on the experimental concentration factory, the high-voltage lines of the industrial construction site, drainage of the quarries of the Far West Mine, units of warehousing facilities and stores of fuel and lubrication materials.

The trust has also not yet started work on expansion of the production facilities of construction and installation organizations, which threatens to stall the start-up of such items of the 11th Five-Year Plan as the second section of the Zhayrem Ore Concentration Combine and the Ushkatyn 3 Manganese Mine.

Dissipation of labor, material and financial resources is to be found in the trust. At the present time, more than 120 facilities are under construction. This has a negative effect on time periods and quality of work. Thus the storage facilities for fuel and lubrication materials took 60 months to build instead of the norm of 14 months and a calcium-carbide storage facility—17 months versus the norm of two months. With the elimination of defective work and alterations in the construction of dwellings at Zhayrem Village by Zhayremtyazhstroy, only 10,200 rubles were spent on wages in 1981 [sic].

The purification facilities which became operational in 1978 with flaws in workmanship still do not provide the necessary purification of sewage. A secondary school that opened in 1979 lacks operational housing, greenhouse and sports area as provided by the plan. The boiler room, garage, residential buildings, stores, snack bars and dining rooms were opened with flaws in workmanship.

Due to an irresponsible attitude by O. Kamzabayev, the chief of food supply of the department of operational supply of Zhayrem Ore Concentration Combine, toward his job, an unfinished vegetable and potato storehouse and a fruit storehouse, which went into operation in the winter of 1980-1981, brought about the spoilage of about 73 tons of potatoes and more than 2 tons of onions worth a total of 12,270 rubles.

The Kazakh SSR Ministry of Ferrous Metallurgy and the Zhayrem Ore Concentration Combine are not creating the necessary conditions for the attainment of projected indicators for extraction of lead, zinc and barite in concentration of Zhayrem ores. Violations of contractual commitments and technical conditions for delivery of the raw ores are one of the reasons for significant losses in the processing of Zhayrem ores at the concentration factories of Achisay Polymetal Combine and Tekeli Lead-Zinc Combine.

The committee obliged the heads of the Ministry of Nonferrous Metallurgy and the Ministry of Construction of Heavy Industry Enterprises of Kazakh SSR to develop and implement the necessary measures for full use of allocated capital investments and fulfillment of plans for the operational start-up of fixed production capital and the attainment of projected indicators for extraction of metals of the mined ores of Zhayrem Ore Concentration Combine.

A. Abdrakhmanov, the director of Zhayremtyazhstroy Trust, has been issued a reprimand for the low organizational level of construction of facilities of Zhayrem Ore Concentration Combine, for making them operational with flaws in workmanship and for losses from poor quality fulfillment of construction and installation work. In partial compensation for the damage done to the state, he was issued a monetary fine.

For accepting and putting into operation the infinished vegetable and potato storehouse and the fruit storehouse, as a result of which a large quantity of vegetables was spoiled, O. Kamzabayev, the chief of food supply of the department of operational supply of Zhayrem Ore Concentration Combine, was issued a severe reprimand. In partial compensation for damage done to the state, he was issued a fine.

For the consistent acceptance and putting into operation facilities for civil housing and production use with low quality of work and a large number of major flaws in workmanship, K. Turlybayev, the chairman of the state acceptance commission and Dzhezkazgan architect, was issued a severe reprimand.

For undermining the organization of mining work and violating contractual commitments for delivery of production, S. Asatov, the director of Zhayrem Ore Concentration Combine, was issued a reprimand.

7697
CSO: 1830/223

DEVELOPMENT OF INDUSTRIAL ULTRASOUND TECHNOLOGY HAMPERED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 2 Jan 82 p 2

[Article by Doctor of Technical Sciences Professor B. Agranat: "Potential of Ultrasonics"]

[Text] When one observes a rolling mill in operation, one cannot help but be amazed at what immense power is required in order to give the required shape to a billet of modest dimensions. Nor is the situation changed by the fact that the billet is heated to a high temperature -- metal, even white hot, offers stiff resistance to the rolls. But then they began applying ultrasound to rolling-mill billets at the Pervoural'sk Novotrubnyy Plant, and the picture changed strikingly. The inaudible acoustic oscillations, figuratively speaking, "rocked" the atoms of the metal, weakened the bonds between them, and it became more compliant. The result was an appreciable increase in equipment productivity and an improvement in product quality.

We could cite many such examples of successful incorporation of ultrasound in traditional processes. But one should first and foremost emphasize their fundamental significance for the economy: in many cases ultrasonic methods make it possible appreciably to improve the performance characteristics of equipment presently in use, and consequently to obtain additional output or to improve product quality without substantial capital outlays.

At the Moscow Carburetor Plant, for example, ultrasound treatment helped accomplish such a difficult task as cleaning carburetors: as a result, equipment productivity doubled, and annual savings amounted to 200,000 rubles. Ultrasound is being used with equal success for cleaning parts at ZIL and the 2d State Bearing Plant. And in the radio engineering industry, in such a laborious operation as the removal of tiny foil whiskers from printed circuits, it has increased productivity fivefold and has substantially improved product quality.

The advantages of ultrasound treatment include versatility, as this technique can be employed in the most diversified areas. Ultrasound provides excellent impregnation of fabrics and fibers, improves combustion of liquid fuel in boilers, settles out industrial dust and smoke, and accelerates drying of objects without greatly increasing temperature. Interesting results have also been produced by research conducted at the Mekhanobr Institute: this research indicated that even the brief application of ultrasound to flotation reagents sharply accelerates the processes of concentration of commercial minerals. Adoption of this technique will produce savings running in the hundreds of thousands of rubles a year just at the Noril'sk Mining and Metallurgical Combine.

It would seem that the great effectiveness of ultrasonic methods should have assured them wide entree into industry. In actual fact, however, we can name today only a few successful examples of their application. Why is this? Could it be that equipment for ultrasound treatment is too complex and costly? No. It does not fundamentally differ from the normal equipment of electroplating shops, for example, and in many instances can be fabricated by the manpower and resources of the interested enterprises themselves. The only thing they cannot build themselves is the sources of the ultrasound -- generators and transducers.

Nor can these devices be considered highly complex. At any rate certain enterprises not only in the instrument engineering, radio engineering and electricical equipment industries but also in the shipbuilding and oil and gas industry, as well as a number of other branches of industry could set up small-scale manufacture of these devices. For the present we lack, however, specialized manufacture of ultrasound sources capable of meeting demand for these devices. And this "lacuna" has become a serious obstacle in the path of an advanced technology.

Indicative in this respect is the example of the Novolipetskiy Metallurgical Plant. In addition to other products, it manufactures strip transformer steel, on which a very thin layer is formed in the process of rolling, a layer which sharply reduces its electromagnetic properties. This in turn leads to a worsening of the characteristics of those devices in which this metal is used -- power transformers, high-frequency equipment, and radio components. Obviously this harmful layer must be removed. But chemical and mechanical methods available up until recently have failed to produce the required quality of steel.

The people at the Moscow Steel and Alloys Institute tackled this problem. Working together with experts at the Novolipetskiy Metallurgical Plant, the Central Scientific Research Institute of Machine Building Technology, and the Moscow Radio Engineering Plant, we developed an automated line for ultrasonic cleaning of the surface of rolled metal. In 1969-1979 four such lines were built and put into operation at the Novolipetskiy Metallurgical Plant. Annual savings from these lines amounted to 1,280,000 rubles. The Main Committee of the Exhibit of Achievements of the National Economy of the USSR, awarding a Certificate 1st Class to the Moscow Steel and Alloys Institute, stated: "For the development, construction and installation of an ultrasonic treatment line, the largest in the Soviet Union and without counterpart abroad."

Of course as the successes of the Lipetsk metallurgical workers became known throughout the industry, the USSR Ministry of Ferrous Metallurgy began receiving large numbers of requests for the new equipment from other enterprises manufacturing similar products. But it was not to be: expansion of the scale of employment of this advanced technology, even within a single industry, was hindered by a shortage of ultrasound sources. Numerous inquiries to the Moscow Radio Engineering Plant, which was manufacturing this equipment, proved fruitless. Ultimately the Ministry of Ferrous Metallurgy was forced to direct these requests to the Moscow Steel and Alloys Institute, but all we could do was recommend to the enterprises... that they themselves obtain the requisite acoustic devices.

As a result the Novolipetskiy Metallurgical Plant, the pioneer in adoption of this new technology, has proven to be in an unenviable position. The acoustic equipment installed at this plant has been gradually wearing out. But there is nothing available to replace it. The Moscow Radio Engineering Plant, in spite of all the requests, not only is not supplying new generators and transducers but is also meetint demand for replacement parts for this equipment by only 25-30 percent. It is not surprising that the output capacity of the ultrasound equipment and the effectiveness of its treatment of the metal are steadily declining, while the quality of the manufactured transformer steel is worsening.

The development of ultrasound technology has been unsuccessful primarily because it is essentially an interbranch problem. And consequently, it finds itself in a "no-man's-land" between the branch departments of the USSR State Committee for Science and Technology and the union Gosplan. In any case, the Gosplan schedule does not yet contain an item entry "Ultrasound industrial equipment and apparatus." And this means that there is no legal foundation for organizing extensive manufacture of such equipment.

Indicative in this regard is the example of another project development by our institute jointly with the Central Scientific Research Institute of Machine Building Technology -- the UZVD-6 ultrasound unit, which makes it possible to increase by hundreds of times the efficiency of processes taking place in liquid media. It can be used to produce metal powders with preselected particle size, to obtain highly-dispersed phosphors for cathode ray tubes, and to clean the surface of precision components in instrument engineering, the clock and watch industry, and in the optical engineering industry. A great many requests for this unit have been received. But things have not yet gone beyond the fact that several years ago the Khar'kov Kommunar Plant and a number of other enterprises built 80 such units for their own needs. But this unit is not yet in series production.

A similar fate has befallen a unique head with magnetostrictive and piezoceramic transducers developed at the Moscow Aviation Institute. Installed on metal-cutting machine tools, it can quickly drill and cut microthreads in hard alloys, diamonds, and other "difficult" materials. There have been thousands of requests for this head, but up to the present time there are only several dozen such devices in operation in this country, crudely put together on the basis of imported components.

And yet we believe that ultrasound technology can and should become one of the important means of intensifying production. There is every opportunity and capability to achieve this. It is necessary merely to conduct in an organized manner efforts to achieve its extensive practical adoption. Much can be accomplished in this area by the State Committee for Science and Technology. We feel that precisely this committee should draw the attention of all interested organizations toward this problem and assume the job of coordinating all efforts. This will make it possible to eliminate duplication of efforts in the activities of scientific and design organizations, to focus them on solving key problems, and to determine the lead organizations and branches responsible for accomplishing specific tasks.

3024
CSO: 1842/62

UDC: 539.415:535.211

PLASTIC DEFORMATION OF KDP GROUP CRYSTALS DAMAGED BY LASER RADIATION

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov-Dec 81 (manuscript received 2 Jul 79) pp 82-85

SHASKOL'SKAYA, M. P., KUGAYENKO, O. M., ARUSHANOV, S. Z. and MEZOVA, R. S., Moscow

[Abstract] A study is made of a plastic and brittle fracture of KDP, DKDP (90% D), RDP and ADP crystals exposed to laser radiation. Single-mode ruby laser radiation with pulse length 10 ns was used, focused by a microscope lens into the body of the (6 x 6 x 12 mm) crystals in the [001] direction, with measurement of the threshold of optical breakdown. The threshold of optical breakdown was found to correlate with the yield point at the temperature at which plasticity begins. This fact and the appearance of individual dislocations in the area exposed to the laser beam indicate that plastic deformation is present, apparently preceding brittle fracture. Photographs are presented of the fracture areas produced by the laser beam in DKDP. Figures 2; references 12: 10 Russian, 2 Western.
[59-6508]

UDC: 533.9

KINETIC PHENOMENA UPON EVAPORATION OF MICROPARTICLES IN LOW-TEMPERATURE PLASMA

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov-Dec 81 (manuscript received 31 Mar 81) pp 17-24

UGLOV, A. A., GNEDOVETS, A. G. and LOKHOV, Yu. N., Moscow

[Abstract] An analysis is presented of the phenomena accompanying heat transfer upon collision of a microparticle with molecules, electrons and ions in a low-temperature equilibrium plasma of a monatomic gas. The case of heating of a microparticle significantly smaller than the free path length of molecules, electrons and ions or the Debye radius of the plasma is studied. Equations are derived for the mean heat fluxes carried by molecules, electrons and ions in the plasma to the surface of the microparticle. The potential to which a microparticle can be charged in the plasma is determined and the time required to reach

this potential is measured. An analysis of heat flux density fluctuations produces correlation equations for the heat fluxes of light and heavy plasma particles. Figures 1; references 10: 8 Russian, 2 Western.
[59-6508]

UDC: 669.782:539.1.04

EFFECT OF DIRECTED STREAM OF IONIZED HALOGEN-CONTAINING GAS ON STRUCTURE OF SILICON SURFACE LAYERS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov-Dec 81
(manuscript received 7 Apr 80) pp 40-43

SHORSHOROV, M. Kh., ZHEBYNEV, D. A., KULIKAUSKAS, V. S., KUZNETSOV, G. D., ABRAMOV, A. S. and KRAPUKHIN, V. V., Moscow

[Abstract] Results are presented from studies of changes in the structural composition of the surface layers of silicon exposed to a directed jet of ionized CF_4 gas. Studies were performed on type KDB-10 silicon plates 400 μm thick by directing the jet against a surface parallel to the (111) plane. The surface of the plate had been chemically and mechanically polished by the usual method with subsequent washing in an ammonia solution. The plates were treated for 180 to 1800 sec, with accelerating voltage 3-5 kV, discharge current 200 mA under static and dynamic (rotating at 30 rpm) conditions. Electronographic analysis showed that the best surfaces were produced on crystals treated while rotating, but even crystals treated while stationary had better surface than the initial untreated crystals. Ion treatment can contaminate the surface with atoms of the electrode material. Iron and tungsten were found on the surface of the crystals after treatment. Annealing is recommended to produce a more stable and defect-free structure. The studies also indicate that exoelectron emission results from defects in the crystalline lattice produced in this case during ion bombardment. Figures 3; references 6: 5 Russian, 1 Western.
[59-6508]

UDC: 539.9

FORMATION OF PLASMA DURING ELECTRON-BEAM EVAPORATION OF METALS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov-Dec 81
(manuscript received 24 Apr 79) pp 44-49

LASHKOV, V. I., ZAYTSEV, Yu. F and GUSEV, O. V., Moscow, Kuybyshev

[Abstract] Experiments were performed on a laboratory electron-beam installation with a chamber volume of 0.5 m^3. The electron gun was capable of generating 5 to 50 kW with an accelerating voltage of 15 kV. An electron beam current of 0.2-3.4 A

was used. The materials evaporated included aluminum, copper, nickel and titanium, selected because of their essentially different physical properties, particularly vapor pressure. A single probe method was used to study the low-temperature plasma produced by evaporation with the electron beam. The experiments indicated that the plasma generated by the electron beam is a slightly ionized, density-heterogeneous, nonisothermal plasma with thermal nonuniformity, space charges and relatively weak macroscopic electric and magnetic fields, which result primarily from disturbances in the plasma generated by the primary electron beam. Figures 4; references 11: 9 Russian, 2 Western.
[59-6508]

UDC: 661.55

INFLUENCE OF SOME TECHNOLOGICAL PARAMETERS ON PROCESS OF PRODUCTION OF TITANIUM NITRIDE

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov-Dec 81
(manuscript received 19 Dec 78) pp 50-53

VOROB'YEV, N. I., MEDVEDEV, D. I., GALITSKIY, N. V. and DMITRIYEV, Yu. M.,
Minsk, Zaporozh'ye

[Abstract] A study is presented of the influence of certain technological parameters on the yield and composition of titanium nitride produced by high temperature ammonolysis of titanium tetrachloride. Studies were performed in a flow-through system with a tubular reactor. It was found that the composition of ammonolysis products depends on the temperature, $NH_3/TiCl_4$ ratio and degree of extraction of hydrogen chloride, which increases with an increase in the flow rate of ammonia at all temperatures until it reaches a maximum, then decreases rapidly due to the interaction of the HCl and the excess ammonia. For each temperature there is a definite relationship assuring complete ammonolysis of the titanium tetrachloride. The titanium nitride produced is near stoichiometric in composition, with residual chlorine content 0.5-3.5%. The content of chlorine decreases with increasing extraction of HCl. Figures 2; references 5: 4 Russian, 1 Western.
[59-6508]

UDC: 669.245-122.4

INFLUENCE OF STRUCTURAL FACTORS ON LIMITING POSSIBILITY OF MANUFACTURING ECONOMICAL PRODUCTS OF COMPLEXLY ALLOYED NICKEL ALLOYS BY CASTING AND HOT DEFORMATION OF BILLETS

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 6, Nov-Dec 81 (manuscript received 19 May 80) pp 79-83

BELOV, A. F., ANOSHKIN, V. N. and KLESHCHEV, A. S., Moscow

[Abstract] An analysis is presented of the possibility of traditional casting and deformation of ingots for further improvement of the production of high nickel alloys with elevated heat resistance. The problem was solved by studying the regularities of formation of the structure of the complex nickel alloys as a function of changes in total content of aluminum and titanium, homogenization conditions, annealing in the two-phase area and its relationship with process ductility. The analysis was based on studies of the formation of the structure of complex EP741 nickel alloy as a function of changes in the total content of aluminum and titanium with a constant Al:Ti ratio of 4. The use of the traditional methods of increasing ductility leads to a great increase in the consumption of scarce materials. Analysis of these studies shows that the progress achieved in the area of smelting and hot deformation has reached the limit of its capacity for nickel alloys with homogeneous structures. Further development of nickel based composites using the traditional technology is economically undesirable or impossible. Basically new technological processes are required such as the metallurgy of granules to allow the creation of more highly alloyed metals with better heat resistance while consuming less scarce materials. References 3: all Russian. [65-6508]

UDC: 669.295'24

EFFECTIVENESS OF VTN-1 ALLOY IN SHAPE RECOVERY

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 6, Nov-Dec 81 (manuscript received 24 Jun 80) pp 135-140

GRANATKIN, Yu. A., KALACHEV, I. B. and MEKHED, G. N., Moscow

[Abstract] A study was made of the mechanical properties and effectiveness of the binary compound Ni-Ti (VTN-1) containing 54.5-55.0 Wt.% Ni. The tests were performed under conditions of partial flexure on specimens cut from a strip 0.4-0.5 mm thick. In order to determine the optimal conditions of stabilizing annealing, the influence of temperature of 1 hour annealing on the level of mechanical properties of the alloy at 20 and 300°C was determined. The results indicate that the mechanical properties of the alloy in the high temperature state depend on the

annealing temperature. The optimal combination of properties in the high temperature state is achieved after stabilization at 400-450°C. It was shown that the optimal mechanical properties overall are achieved by stabilizing annealing at 450-500°C. The maximum reactive stress is achieved with 2.0-2.5% plastic deformation. The optimal usage temperature assuring most complete shape recovery and preservation of the maximum values of reactive stress is 250-280°C. The experimental functions obtained can be used to design heat sensing elements of alloys with the shape memory effect. Figures 5; references 18: 8 Russian, 10 Western.
[65-6508]

UDC: 669.669.245:621.785.78

INFLUENCE OF DIMENSIONAL NONCONFORMITY OF CRYSTALLINE LATTICE PERIODS OF γ and γ' PHASES ON HEAT RESISTANCE CHARACTERISTICS OF DISPERSION HARDENED NICKEL ALLOYS

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 6, Nov-Dec 81
(manuscript received 18 Aug 80) pp 153-159

PETRUSHIN, N. V., IGNATOVA, I. A., LOGUNOV, A. V., SAMOYLOV, A. I. and
RAZUMOVSKIY, I. M., Moscow

[Abstract] The periods of the γ and γ' phase crystalline lattices of nickel heat resistant alloys Ni-Cr-Co-W-Al-Ti-Nb-Hf of type MAR-M200 produced by equiaxial crystallization with various chemical compositions were studied. X-ray studies were performed at 293 and 1173°K in a vacuum of 10^{-2} pa in a high temperature x-ray chamber. In most of the alloys studied the lattice period of the solid solution was less than the γ' phase lattice period. The lattice period of the intermetallide γ' phase was less sensitive to changes in alloy composition than the γ solid solution lattice period. An increase in the content of chromium and tungsten leads to a decrease in the absolute value of disagreement of the lattice periods. Cobalt and niobium have no significant influence. Alloying yielding a smaller γ solid solution lattice period than the γ' phase period leads to lower heat resistance properties and significant differences in coefficients of thermal expansion of the phases. Possible mechanisms are discussed for the influence of the dimensional disagreement of lattice periods on strength and kinetics of the process of coagulation of the second phase of heterophase alloys at high temperatures. Figures 3; references 16: 12 Russian, 4 Western.
[65-6508]

UDC: 669.245-172:539.376

LONG TERM STRENGTH OF SINGLE CRYSTALS OF NICKEL HEAT RESISTANT ALLOYS

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 6, Nov-Dec 81
(manuscript received 19 Aug 80) pp 160-164

LYUTTSAU, V. G., KOSTYUKOVA, Ye. P., TOLORAIYA, V. N. and KOSTINA, I. V., Moscow

[Abstract] A study was made of single crystals of ZhS-6U heat resistant nickel alloy grown in the [001], [011] and [111] directions. Long term strength testing was conducted at 975°C with a stress of 26-28 kg/mm^2 and at 1100°C at a stress of 12 kg/mm^2. Structural studies were performed by metallographic and x-ray methods. The [111] direction yields a significant gain in long term strength. In the process of creep a block structure with a block size of 0.1-0.2 mm is formed in the crystals. The transition from the second to the third stage of creep does not involve the formation of macroirregularities in specimens with single crystal structure. Cracks are formed primarily at segregations of carbides at the end of the third stage. Figures 4; references 3: 2 Russian, 1 Western.
[65-6508]

INFLUENCE OF HIGH ENERGY ELECTRON BOMBARDMENT ON STRUCTURE OF TYPE 65G STEEL

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 5, Sep-Oct 81
(manuscript received 11 Jun 79) pp 29-31

GRUZIN, P. L., ALEKSANDROVA, N. M. and VASIL'YEV, A. A., Moscow

[Abstract] The method of bombardment of steels and alloys with high energy electrons in order to improve the usage properties of metal products has become widespread in recent years. Such types of working as hardening, alloying, and melting of metal materials using beams of electrons with energies of up to 150 KeV have been studied. A number of works have appeared on the influence of electron-thermal treatment on the physical and mechanical properties of steels and alloys. More detailed study of the effects of a powerful electron beam on the structure of a hardened layer and the kinetics of phase transformations is required to improve the technology of this processing and allow broader utilization of the method of surface hardening by high energy electron beams. A study was made of the influence of rapid heating with high energy electrons on the structure and properties of type 65G steel. Specimens were bombarded on a type ELU-5-1-5 linear electron accelerator with an electron energy of 5 MeV (beam diameter 8 mm). The specimens were than quenched in water, producing a hardened layer 4-5 mm deep where the electron beam struck the specimen. It was found that the bombarded

volume includes a range of structures from martensite to the initial structure with a smooth transition zone. This distribution of structures allows good mechanical bonding of the hardened zone to the remainder of the specimen and increases the contact strength of the specimen. By changing the intensity and duration of bombardment, it is possible to regulate the distribution of temperature in the zone struck by the electron beam, varying the relative dimensions within the hardened and transition zones. Figures 2; references 4: all Russian.
[55-6508]

EFFECT OF SPARK DISCHARGE AND ELECTROLYTIC PLASMA ON SURFACE LAYER OF METALS

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 5, Sep-Oct 81
(manuscript received 3 Nov 80) pp 26-28

MIKHAYLOV, V. V., DURADZHI, V.N., GITLEVICH, A Ye. and ANDREYEVA, L. N., Kishinev

[Abstract] Combined methods of working are used to produce the necessary physical and chemical properties of metal surfaces, by applying a layer of pure metal or alloy to the surface of a part, then treating it with chemicals or heat. Heating in an electrolytic plasma can be achieved by immersing the part in an electrolyte or by means of a sprayer, which allows local treatment without the use of special shielding. However, at present, only two elements can be diffused from an electrolyte by this method--carbon and nitrogen. To expand the range of elements and of physical-chemical properties of the treated surfaces, specimens were preliminarily subjected to electric spark alloying using electrodes of various metals. Coatings of chrome and nickel 10 to 15 μm thick were applied to a portion of cylindrical specimens of titanium and armco iron, then electric spark alloying was performed using chromium, titanium, iron and nickel. The specimens were treated in two solutions: an aqueous solution of 15% ammonium chloride and 25% aqueous ammonia for nitriding, and an aqueous solution of 25% ammonium chloride and 10% acetone for carburizing. The effect of the spark discharge on the surface layer of the metals was found to create the prerequisites for deep diffusion during subsequent heating, while the heating itself in the electrolyte plasma enriches the surface layer of the coating and the metal with carbon or nitrogen, leading to an additional change in the properties of the layers. Figures 4; references 8: 7 Russian, 1 Western.
[55-6508]

UDC: 621.74.002.6:Δ669.14.018.44

INCREASE IN LIFE OF REFRACTORY CASTINGS FOR THERMAL EQUIPMENT PARTS

Moscow LITEYNOYE PROIZVODSTVO in Russian No 11, Nov 81 pp 21-23

BULETOV, Yu. B., engineer, KVASHA, F. S. and LAMASOV, A. A.,
candidates of technical sciences, MISHUROVA, T. A. and TETERIN, B. A., engineers

[Abstract] A study was made of castings operating under severe conditions either in terms of heavy loads or furnace atmospheres. Analysis showed that the main reasons for failure of furnace parts include accumulation of impurities in the alloy, casting defects, or insufficient refractoriness of the alloy used. Tests were conducted to find steel types to replace the Kh20N37 used in furnace parts. An austenitic solid solution containing 25% Cr and 18-20% Ni, remainder Fe, was used as the basis. The hardening elements used were W, C and B. The influence of the various elements on strength properties of the steels was evaluated. The strongest steel was Kh25N20 with less than 1% Nb; the most conductile was Kh25N20 with about 3% Si, which also withstood the greatest number of heating and cooling cycles (125). Figures 1.
[56-6508]

UDC: 621.74:669.715:Δ621.9.048.6

ULTRASONIC PROCESSING OF ALUMINUM ALLOY WITH Ni AND Si

Moscow LITEYNOYE PROIZVODSTVO in Russian No 11, Nov 81 p 8

KISIN, V. I. and PRISTAVKO, I. V., engineers

[Abstract] Ultrasonic processing reduces the particle size of the macrostructure and microstructure of a metal and increases homogeneity. In this work the principle of applying US oscillations to a melt during crystallization in a chill mold was used, without including the mold in the oscillating system. The alloy used in the study included 12-17% Si and 15-17% Ni, remainder Al. The optimal conditions were determined, significantly reducing grain size: pour alloy at 700°C; chill mold temperature 240°C; volume of alloy 120 cm^3; amplitude of excitation of end of conical concentrator of oscillations 30 μm; power applied to the convertor 1.5 to 2 kW; oscillating frequency 18 to 18.5 KHz. Ultrasonic processing caused more uniform distribution of the elements in the alloy and very fine particle size. Figures 1.
[56-6508]

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MARCH 17, 1982